DOE performed an accident screening process to identify credible accidents that could occur at an intermodal transfer station with the potential for compromising the integrity of the casks and releasing radioactive material. The external events listed in Table J-51 were considered, along with an evaluation of their potential applicability.

As indicated from Table J-51, the only accident-initiating event identified from among the feasible external events was the aircraft crash. Such events would be credible only for casks being handled or on transport vehicles at an intermodal transfer station in the Las Vegas area (Apex/Dry Lake or Sloan/Jean).

For a station in the Las Vegas area, an aircraft crash would be from either commercial aircraft operations at McCarran airport or military operations from Nellis Air Force Base.

Among the internal events, the only potential accident identified was a drop of the cask during transfer operations. This accident would bound the other events considered, including drops from the railcar or truck (less fall height would be involved than during the transfer operations). Collisions, derailments, and other accidents involving the transport vehicles at the intermodal transfer station would not damage the casks due to the requirement that they be able to withstand high-speed impacts and the low velocities of the transport vehicles at the intermodal transfer station.

Accident Analysis

1. *Cask Drop Accident.* The only internal event retained after the screening process was a failure of the gantry crane (due to mechanical failure or human error) during the transfer of a shipping cask from a railcar to a heavy-haul truck. The maximum height between the shipping cask and the ground during the transfer operation would be less than 6 meters (19 feet) (DIRS 104849-CRWMS M&O 1997, all). The casks would be designed to withstand a 9-meter (30-foot) drop. Therefore, the cask would be unlikely to fail during the event, especially because the impact energy from the 6-meter drop would be only 65 percent of the minimum design requirement.

2. *Aircraft Crash Accident.* This section, including Tables J-52 and J-53, has been moved to Volume IV of this EIS.

J.3.4 IMPACTS IN NEVADA FROM INCIDENT-FREE TRANSPORTATION FOR INVENTORY MODULES 1 AND 2

This section presents the analysis of impacts to occupational and public health and safety in Nevada from incident-free transportation of spent nuclear fuel and high-level radioactive waste in Inventory Modules 1 and 2. The analysis assumed that the routes, population densities, and shipment characteristics (for example, radiation from shipping casks) for shipments under the Proposed Action and Inventory Modules 1 and 2 would be the same. The only difference was the projected number of shipments that would travel to the repository.

The following sections provide detailed information on the range of potential impacts to occupational and public safety and health from incident-free transportation of Modules 1 and 2 that result from legal-weight trucks and the 10 alternative transportation routes considered in Nevada. National impacts of incident-free transportation of Modules 1 and 2 incorporating Nevada impacts are discussed together with other cumulative impacts in Chapter 8.

J.3.4.1 Mostly Legal-Weight Truck Scenario

Tables J-54 and J-55 list estimated incident-free impacts in Nevada for the mostly legal-weight truck scenario for shipments of materials included in Inventory Modules 1 and 2.

Table J-51. Screening analysis of external events considered potential accident initiators at intermodal transfer station.

Event	Applicability
Aircraft crash	Retained for further evaluation
Avalanche	(a)
Coastal erosion	(a)
Dam failure	See flooding
Debris avalanching	(a)
Dissolution	(b)
Epeirogenic displacement (tilting of the earth's crust)	(c)
Erosion	(b)
Extreme wind	(c)
Extreme weather	(e)
Fire (range)	(b)
Flooding	(d)
Denudation (loss of land cover)	(b)
Fungus, bacteria, algae	(b)
Glacial erosion	(b)
High lake level	(b)
High tide	(a)
High river stage	See flooding
Hurricane	(a)
Inadvertent future intrusion	(b)
Industrial activity	Bounded by aircraft crash
Intentional future intrusion	(b)
Lightning	(c)
Loss of off/on site power	(c)
Low lake level	(b)
Meteorite impact	(e)
Military activity	Retained for further evaluation
Orogenic diastrophism (tectonic ground movement)	(e)
Pipeline accident	(b)
Rainstorm	See flooding
Sandstorm	(c)
Sedimentation	(b)
Seiche (sudden water-level change)	(a)
Seismic activity, uplifting	(c)
Seismic activity, earthquake	(c)
Seismic activity, surface fault	(c)
Seismic activity, subsurface fault	(c)
Static fracturing	(b)
Stream erosion	(b)
Subsidence	(c)
Tornado	(c)
Tsunami (tidal wave)	(a)
Undetected past intrusions	(b)
Undetected geologic features	(b)
Undetected geologic processes	(c)
Volcanic eruption	(e)
Volcanism, magmatic activity	(e)
Volcanism, ash flow	(c)
Volcanism, ash fall	(b)
Waves (aquatic)	(a)

a. Conditions at proposed sites do not allow event.
b. Not a potential accident initiator.
c. Bounded by cask drop accident considered in the internal events analysis.
d. Shipping cask designed for event.
e. Not credible, see evaluation for repository.

Table J-54. Population doses and radiological impacts from incident-free Nevada transportation for mostly legal-weight truck scenario–Modules 1 and 2.[a]

Category	Legal-weight truck shipments	Rail shipments of naval spent nuclear fuel[b]	Total[c]
Module 1			
Involved worker			
Collective dose (person-rem)	3,700	21	3,700
Estimated latent cancer fatalities	1.5	0.008	1.5
Public			
Collective dose (person-rem)	680	10	690
Estimated latent cancer fatalities	0.34	0.005	0.35
Module 2			
Involved worker			
Collective dose (person-rem)	3,800	23	3,900
Estimated latent cancer fatalities	1.5	0.009	1.5
Public			
Collective dose (person-rem)	700	13	710
Estimated latent cancer fatalities	0.35	0.007	0.36

a. Impacts are totals for shipments over 38 years.
b. Includes impacts at intermodal transfer stations.
c. Totals might differ from sums due to rounding.

Table J-55. Population health impacts from vehicle emissions during incident-free Nevada transportation for the mostly legal-weight truck scenario–Modules 1 and 2.[a]

Vehicle emission-related fatalities	Legal-weight truck shipments	Rail shipments of naval spent nuclear fuel[b]	Total[c]
Module 1	0.17	0.0069	0.18
Module 2	0.18	0.0081	0.19

a. Impacts are totals for shipments over 38 years.
b. Includes heavy-haul truck shipments in Nevada.
c. Totals might differ from sums due to rounding.

J.3.4.2 Nevada Rail Implementing Alternatives

Table J-56 lists the range of estimated incident-free impacts in Nevada for the operation of a branch rail line to ship the materials included in Inventory Modules 1 and 2. It lists impacts that would result from operations for a branch line in each of the five possible rail corridors DOE is evaluating. These include the impacts of about 3,100 legal-weight truck shipments from commercial sites that could not use rail casks to ship spent nuclear fuel.

J.3.4.3 Nevada Heavy-Haul Truck Implementing Alternatives

Radiological Impacts

Intermodal Transfer Station Impacts. Involved worker exposures (the analysis assumed that the noninvolved workers would receive no radiation exposure and thus required no further analysis) would occur during both inbound (to the repository) and outbound (to the 77 sites) portions of the shipment campaign. DOE used the same involved worker level of effort it used in the analysis of intermodal transfer station worker industrial safety impacts to estimate collective involved worker radiological impacts (that is, 16 full-time equivalents per year). The collective worker radiation doses were adapted from a study (DIRS 104791-DOE 1992, all) of a spent nuclear fuel transportation system, which was also performed for the commercial sites. That study found that the collective worker doses that could be incurred during similar inbound and outbound transfer operations of a single loaded (with commercial

Table J-56. Radiological and nonradiological impacts from incident-free Nevada transportation for the rail implementing alternatives–Modules 1 and 2.[a]

Category	Legal-weight truck shipments	Rail shipments	Total[b]
Involved worker			
Collective dose (person-rem)	110	1,300 - 1,900	1,400 - 2,000
Estimated latent cancer fatalities	0.04	0.52 - 0.76	0.56 - 0.8
Public			
Collective dose (person-rem)	19	106 - 640	130 - 659
Estimated latent cancer fatalities	0.01	0.05 - 0.32	0.07 - 0.33
Estimated vehicle emission-related fatalities	0.0046	0.012 - 0.38	0.016 - 0.38

a. Impacts are totals for shipments over 38 years.
b. Totals might differ from sums due to rounding.

spent nuclear fuel) and unloaded cask were approximately 0.027 and 0.00088 person-rem per cask, respectively, as listed in Table J-57.

Table J-57. Collective worker doses (person-rem) from transportation of a single cask.[a,b]

Inbound	Inbound CD[b]	Outbound	Outbound CD
Receive transport vehicle and loaded cask. Monitor, inspect, unhook offsite drive unit, and attach onsite drive unit.	6.3×10^{-3}	Receive transport vehicle and empty cask. Monitor, inspect, unhook offsite drive unit, and attach onsite drive unit.	0.0
Move cask to parking area and wait for wash down station. Attach to carrier puller when ready.	1.4×10^{-3}	Move cask to parking area and wait for wash down station. Attach to carrier puller when ready.	5.4×10^{-4}
Move cask to receiving and handling area.	9.2×10^{-5}	Move cask to receiving and handling area.	8.0×10^{-6}
Remove cask from carrier and place on cask cart.	4.3×10^{-3}	Remove cask from carrier and place on cask cart.	2.2×10^{-4}
Connect onsite drive unit and move cask to inspection area; disconnect onsite drive unit.	7.0×10^{-4}	Connect onsite drive unit and move cask to inspection area; disconnect onsite drive unit.	3.3×10^{-5}
Hook up offsite drive unit, move to gatehouse, perform final monitoring and inspection of cask.	1.4×10^{-2}	Hook up offsite drive unit, move to gatehouse, perform final monitoring and inspection of cask.	8.3×10^{-5}
Notify appropriate organizations of the shipment's departure.	0.0	Notify appropriate organizations of the shipment's departure.	0.0
Total	2.7×10^{-2}	*Total*	8.8×10^{-4}

a. Adapted from DIRS 104791-DOE (1992, Table 4.2).
b. Values are rounded to two significant figures; therefore, totals might differ from sums of values.
c. CD = collective dose (person-rem per cask).

The analysis used these inbound and outbound collective dose factors to calculate the involved worker impacts listed in Table J-58 for Module 1 and Module 2 inventories in the same manner it used for commercial power reactor spent nuclear fuel impacts. The number of inbound and outbound shipments for Module 1 and Module 2 inventories is from Section J.1.2. The worker impacts reflect two-way operations.

Incident-Free Transportation. Table J-59 lists the range of estimated incident-free impacts in Nevada for the use of heavy-haul trucks to ship the materials included in Inventory Modules 1 and 2. It lists impacts that would result from operations on each of the five possible highway routes in Nevada DOE is evaluating. These include impacts of about 3,100 legal-weight truck shipments from commercial sites under Modules 1 and 2 that could not ship spent nuclear fuel using rail casks while operational.

Table J-58. Doses and radiological health impacts to involved workers from intermodal transfer station operations – Modules 1 and 2.[a,b]

	Module 1		Module 2	
Group	Dose (millirem)	Latent cancer fatality	Dose (millirem)	Latent cancer fatality
Maximally exposed individual worker	12	0.005[c]	12	0.005
Involved worker population	500	0.20[d]	520	0.21

a. Includes estimated impacts from handling 300 shipments of Naval spent nuclear fuel that would be shipped by rail under the mostly legal-weight truck transportation scenario.
b. Totals for 38 years of operations.
c. The estimated probability of a latent cancer fatality in an exposed individual.
d. The estimated number of latent cancer fatalities in an exposed involved worker population.

Table J-59. Radiological and nonradiological health impacts from incident-free transportation for the heavy-haul truck implementing alternatives – Modules 1 and 2.[a]

Category	Legal-weight truck shipments	Rail and heavy-haul truck shipments[b]	Total[c]
Involved worker			
Collective dose (person-rem)	110	2,100 - 3,100	2,200 - 3,300
Estimated latent cancer fatalities	0.04	0.85 - 1.3	0.89 - 1.3
Public			
Collective dose (person-rem)	19	100 - 580	120 - 600
Estimated latent cancer fatalities	0.01	0.05 - 0.29	0.06 - 0.3
Estimated vehicle emission-related fatalities	0.0046	0.0096 - 0.35	0.014 - 0.35

a. Impacts are totals for 38 years.
b. Includes impacts to workers at an intermodal transfer station.
c. Totals might differ from sums due to rounding.

J.3.5 IMPACTS IN NEVADA FROM TRANSPORTATION ACCIDENTS FOR INVENTORY MODULES 1 AND 2

The analysis assumed that the routes, population densities, and shipment characteristics (for example, assumed radioactive material contents of shipping casks) for the Proposed Action and Inventory Modules 1 and 2 would be the same. The only difference would be the projected number of shipments that would travel to the repository. As listed in Table J-1, Module 2 would include about 3 percent more shipments than Module 1.

J.3.5.1 Mostly Legal-Weight Truck Scenario

Radiological Impacts

The analysis estimated the radiological impacts of accidents in Nevada for the mostly legal-weight truck scenario for shipments of the materials included in Inventory Modules 1 and 2. The radiological health impacts associated with both Modules 1 and 2 would be 0.1 person-rem (see Table J-60). These impacts would occur over 38 years in a population of more than 1 million people who lived within 80 kilometers (50 miles) of the Nevada routes that DOE would use. This dose risk would lead to less than 1 chance in 1,000 of an additional cancer fatality in the exposed population. For comparison, in Nevada about 240,000 in a population of 1 million people would suffer fatal cancers from other causes (DIRS 153066-Murphy 2000, p. 83).

Traffic Fatalities

The analysis estimated traffic fatalities from accidents involving the transport of spent nuclear fuel and high-level radioactive waste by legal-weight trucks in Nevada for the mostly legal-weight truck scenario for shipments of the materials included in Inventory Modules 1 and 2. It estimated that there would be